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AMCIS 2002 Proceedings

Americas Conference on Information Systems (AMCIS)

December 2002

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Abstract

This paper describes a project which is developing a simulated economic environment in which operates a virtual supply chain based on the manufacturing and sales of personal computers. The supply chain is modeled in SAP R/3. The project is called the SAP Student Marketplace for the Advancement of Research and Training (SAP SMART).

The aim of the project is to develop a richly populated simulation environment in which participating institutes of higher learning will be able to develop and deliver world-class, technology-enabled business and management education programs utilizing the mySAP.com e-business applications to their full extent. Potential users of this system include all members of the SAP University Alliance Program which currently consists of over 300 universities in the USA, Australia, Europe, South America and Asia.

There are five universities developing this virtual marketplace consisting of three US, one South American, and one Australian Universities. Thus, the development of this teaching environment is an example of collaboration and teamwork among people from different cultures and backgrounds. Its extensions will continue the international collaboration by extending to Europe and Asia.

Introduction

Enterprise systems are being introduced into the Business and Information Systems curriculum in a variety of institutions. There is a need to develop IT students that have business knowledge, and business students that have IT knowledge (Microsoft Press, 1998, Gartner Group, 1998). A number of efforts to link academic study towards industry needs took place in order to achieve this goal. Professional societies have defined a body of requisite IT knowledge (e.g. ACS Core Body of Knowledge 1997) and

IT Societies around the world have called for increased relevance of IT education (British Computer Society, 1999, IEEE, 1999, ACM, 1997, ACM, 1999, Australian Computer Society 2000). These activities have led to the formation of various collaborative curriculum committees to address this issue (IS 97, Davis et al., 1997), (ISCC'99, Lidtke and Stokes, 1999), (IS 2000, Longenecker et al., 1999).

Over the last several years, a number of universities internationally have been using Enterprise Resource Planning (ERP) Software (SAP R/3, PeopleSoft, Oracle Financials, OneWorld) as a means of providing access to these functioning application systems. These universities are using this software in their business, engineering and information technology curriculum programs. Numerous IS conferences have had mini-tracks directly addressing this adoption of ERP into the curriculum (Americas Conference on Information 1999, 2000,2001 and 2002, European Conference on Information Systems 1999, 2000,and 2001, the Australasian Conference on Information Systems 1998, and the International Conference on Information Systems 1998). Business education is seeking to use Enterprise Systems within their curriculum as well as seen in the Decision Sciences Conferences 1999, 2000 and 2001.

The Information Systems-Centric Curriculum Document (1999) was the output of a collaborative review process held in the USA, with industry and academic participation. This curriculum committee sought to identify the skills required in developing and supporting large and complex systems in use within government, industry and defence. It recommends that students should undertake IT curriculum which has students experience and analyze real application systems from the beginning of their course (AMCIS Proceedings 1999: 204). This requires students to have exposure to a real and functioning application system. The ISCC committee identified the skills required for industry, and these are shown in Table 1.

Table 1. Skills of an Industry Ready IT Graduate (Information Systems Centric Curriculum)

INDUSTRY-DEFINED ATTRIBUTES OF AN ISCC'99 GRADUATE		
Personal Skills	Systemic-thinking skills Problem-solving skills Critical-thinking skills Risk-taking skills	Personal-discipline skills Persistence Curiosity
Interpersonal Skills	Collaborative skills Conflict resolution skills	Communication skills (oral, written, listening, and group)
Technical Knowledge and Skills	Information abstraction, representation, and organization Enterprise computing architectures and delivery systems Concepts of information and systems distribution Human behavior and computer interaction	Dynamics of change Process management and systems development Information Systems domain knowledge Use of computing tools to apply knowledge

The ISCC 99 curriculum document also recommends that an inverted curriculum model be used. In this approach, the student experiences the context of the information system, then masters the details and finally returns to a systems view of the deployment of the technology in order to complete their experience. We argue that this approach is equally valid in management education as the students require some real world grounding in order to make sense of the management activities and theories. As educationalists, we have seen the value of this approach in making the theoretical material more apprehendable to undergraduate students without work experience. In addition, the advanced features of most ERP products also support the advanced decisions required of the business executive. Hence, using the management information systems and executive information systems reporting functions in a fully populated business model will add value to executive education and MBA programs.

This type of approach has led several universities to seek means to ground their business curriculum in a real-world context. In addition, other business and engineering curriculum documents have emphasized similar needs in developing the personal and interpersonal skills of graduates.

Gable and Rosemann (1999) give an overview about SAP-related activities at universities. Hawking (1998), Lederer-Antonucci (1998) and Watson and Schneider (1999) discuss success factors for the integration of ERP into the IS curriculum. Scott (1999)

analyses different learning styles for their appropriateness regarding ERP. Stewart et al. (1999), Watson and Noguera (1999) and Watson et al. (1999) reflect their experiences in teaching ERP. Hawking et al. (1999) reviews ERP-activities at Australian Universities, and shows how such curriculum addresses the IS '97 curriculum.

Though the awareness for the need to teach Enterprise Resource Planning increased significantly over the last years, appropriate literature that goes beyond an explanation of product-specific functionality is still missing. A number of Enterprise Systems vendors are supporting business and management education through providing free software. These vendors include SAP, Peoplesoft, Oracle and JD Edwards. These companies have also sponsored University Alliance Programs, with SAP having the largest number of university partners. But the provision of free software is not sufficient for the information system to be of use within these programs. What is needed is a rich set of teaching resources that are developed to meet the needs of undergraduate and post-graduate education. There is a requirement to find a cost-effective means to develop a set of teaching cases designed to overcome this situation. The goal of this project is to address this problem.

This paper describes the development of the simulation environment. This project is supported by SAP USA through its Centre for Innovation. The project has 3 phases. Phase 1 is due for completion January 31 2002 and involves the conceptual planning of the virtual supply chain. Phase 2 consists of the building of the prototype virtual supply chain and its implementation in SAP R/3. This phase is due for completion 31 July 2002. Phase 3 consists of testing the prototype through use in the curriculum of the participating universities between 1 August 2002 and 31 January 2003.

We commence by examining the project design objectives and then review the functionality of an extended enterprise system. We then present the project in the context of an extended enterprise system and detail the business concepts that can be taught in this environment. We close by reviewing the project scope and call for partners to use the system once it is released for general use.

Project Design

The project vision is to develop and test a role-based, technology-enabled marketplace that connects universities and their students in a virtual industry that encourages and facilitates "real-world" undergraduate, graduate, and executive education. The proposed system will simulate a worldwide business process from the viewpoints of all levels of management within manufacturer, supplier, retailer and end customer environments. Students will get the unique experience of an elaborated hands-on e-commerce solution. It will allow students to test their decision-making skills at both the tactical and strategic management levels while concurrently providing a solid foundation for education and training across a broad spectrum of student experience levels. Furthermore, it will educate all participants in virtual teamwork.

This project has been designed to develop, pilot and populate a virtual enterprise system exercising the full range of business processes found in an extended enterprise. This extended enterprise will have companies that play the supplier, vendor, retailer and manufacturer roles. A full supply chain integrating each of the activities of each virtual company must be developed. The vision is for universities to be able to participate in the virtual supply chain in any role: vendor, manufacturer, retailer or consumer. The supply chain will be in a virtual global economy, in which economic variables are modified regularly in order to provide real-world noise. The impact of these external variables on the virtual supply chain becomes the target for simulated management decisions.

SAP SMART's pilot business environment will enable student teams to interact between the participating schools in the operation of a limited, electronic business simulation marketplace. It will provide a unique and challenging opportunity where students will use prior knowledge and concepts garnered in their education to make decisions that will ultimately lead to a better understanding of business and an enhanced set of skills and tools.

Universities can elect to participate as consumers of virtual products and track their orders through the supply chain. This allows undergraduate students to understand the notions implicit in process models of organizations and to reflect on how organizational structures and management practices either support or inhibit process effectiveness and efficiencies.

It is also possible to universities to acquire a company on the supply chain thus undertaking a more active role in the simulation. In this mode, universities set the target goals, compete with other providers for market share and become more intimate with the process models supporting their business activities.

An alternative mode of engagement is for the university to design a company to compete in the market place. This involves developing a business plan (including vision, mission, goals, objectives, and key performance indicators), developing the appropriate organizational structures necessary to achieve the plan, configuring their own company in the SAP environment and then actively trading in the virtual supply chain.

Finally, as more universities use the virtual environment and create a large volume of transactions, sufficient information will be populated in the system database to support advanced decision making, using products such as Business Information Warehouse (BW) and Strategic Enterprise Management (SEM).

The supply chain that is used in this project is shown in figure 1.

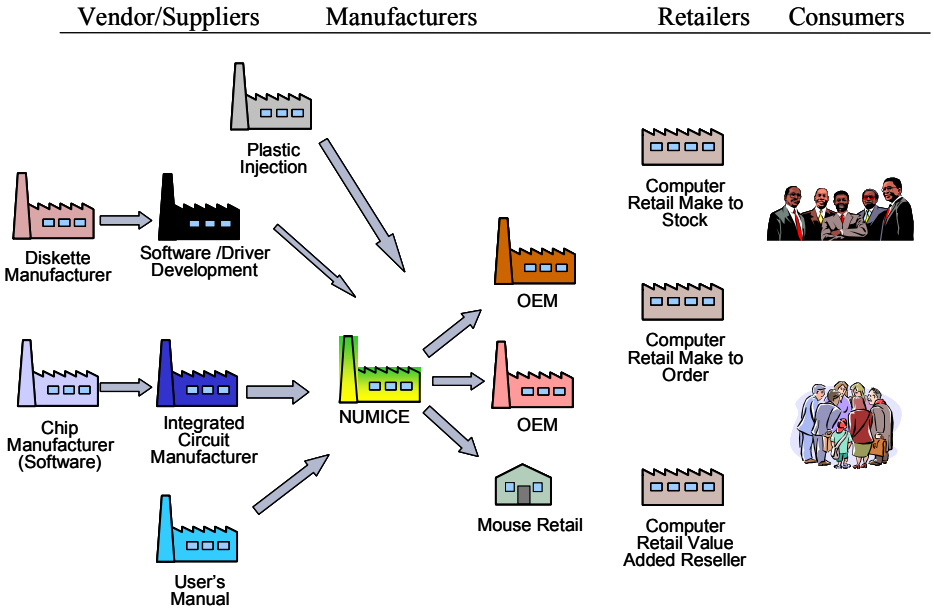

Figure 1. Virtual Supply Chain

Each participating institute will take one of these roles: vendor/suppler, manufacturer, retailer or consumer. The required design, implementation and execution of these collaborative scenarios will add significant value to the local education in Enterprise Systems. Student teams will use this environment for demonstrating business processes within each component, and can use the architecture to demonstrate the functions of E-business.

The project is in the design and build phase at this stage. In the second half of the year, these universities will be testing their models through use of the facility in their under-graduate business, engineering and IT classes. Each university will have at least one class acting as consumers, generating demand for products. The mouse manufacturer and monitor manufacturer will be making to stock and supplying their virtual stock to the systems integrator, who in turn will be supplying to the retailers. Note that the mouse manufacturer actually produces optical mice within a student factory as part of their production engineering courses. It is conceivable that other universities may similarly wish to actualize their roles!

Once the initial schools are satisfied with the simulated environment, its usability and stability, the vision is to expand the group of marketplace participants by inviting additional international schools to enter the game. Concurrently, it is expected that the system will be modified to permit testing and assessment of new SAP products and partner products in this virtual marketplace. Finally, this project and its deliverables could eventually become a part of a Global Solutions Center offering the advantage of a functioning environment that is capable of quickly assessing and demonstrating the feasibility of new business functionality.

This means of using a 'real' Enterprise System – populated with actual transaction data, using a simplified supply chain, gives the student practical exposure to material formerly only abstractly known. The Enterprise System provides a rich teaching medium, with populated business processes. This model is being developed in SAP R/3, which has detailed process models for over 800 standard business processes. Many of these process models are world best-practice models. The Enterprise System

technical environment is a complex example of all the components needed to power a multi-national organization - client server environments using centralized database systems accesses through web enabled front ends. The newer extensions to Enterprise Systems to embrace Supply Chain Management and Customer Relationship management also provides the platform to teach about the modeling and technologies that service the E-Commerce world.

Current Activities

Current activities involve the design, and configuration of two vendor/suppliers (one supplying mice and one supplying monitors), one manufacturer/assembler (OEM), and two retailers. One retailer will operate in a make to stock mode and the other retailer will operate in a make to order mode. These configuration activities will lead to functioning models operating within individual SAP R/3 instances. Each participating university either has access to their own SAP R/3 site or can purchase services from a University Application Hosting Centers. These centers are also called University Competency Centers (or UCCs). Current USA centers include University of Missouri, University of Wisconsin at Milwaukee, and California State University at Chico with the Louisiana State University at Baton Rouge to go live in 2002. International centers include Queensland University of Technology in Australia, and the Universities of Passau and Magdeburg in Germany. It is envisaged that schools seeking to use SAP SMART will obtain access through their local UCC.

We are now completing the development of the individual business models. This has involved developing the organisational structure and defining the SAP R/3 organisational elements. This culminates in a data model. Following the construction of the data model, the master data and configuration data are evolved. Finally the students populate the system with these design elements and have a working system. This phase of the project has students working in a multi-disciplinary team (business, engineering and IT students) to establish the business structures required for an effective e-commerce business. From this design, the students will then go onto configure a functioning system operating in SAP R/3. This involves identifying appropriate business processes from the Reference Model that supports the e-business activity. They are also developing a detailed collaborative e-business scenario, which will determine the information flows between businesses on the virtual supply chain. Students are thus learning how to integrate activities and developing the generic skills asked according to the ISCC'99 document. Thus, the participating students are being exposed to many learning experiences in business, information systems, and engineering throughout the life of the project.

In addition, Information Systems students at two partnering institutions are establishing the technical architecture for direct business to business connection. This involves the exchange of iDocs wrapped in XML. Two technical teams are making the connections between two live SAP R/3 sites. In addition, students are extending a on-line shopping cart to support customers ordering directly from the virtual retailer. These students are refining the design of a make to stock on-line store, to one that supports a make to order virtual retailer. In addition, these students are critically evaluating the on-line store facilities inherent in the product range (through the sales and distribution module and the customer relationship management modules) and in an evolving product range (the marketplace).

We have found that the students are indeed challenged by the complexity of the configuration task. Configuration requires a solid understanding of business principles, as well as interpreting what these principles mean in the context of SAP dictionary terms. We had a green field site, so the challenge to the students were to design a functioning E-Business not constrained by any physical boundaries, but needing to recognise how the geographical location of suppliers, vendors and consumer impact on business design. These lessons will be documented once the construction phase is completed.

Following the construction phase, the partnering Universities will test the design. Three of the underlying core business concepts of this project are economic demand, systems development, and decision-making. Initially, students will experience first-hand the impact of economic demand on all the business processes of an organization. This will be accomplished through the use of case exercises where students generate and respond to independent demand. It is anticipated that most of the students from all of the participating schools will be exposed to this component of the project.

We will test the utility of this virtual enterprise in achieving the objectives of business and IT education in the coming semester. We hope to report in subsequent conferences on the experiences from both student and lecturer viewpoints.

Conclusion

The development of a functioning business model that exercises the full supply chain increases students knowledge of the issues involved in supply chain management, customer relation management and the need to integrate diverse applications to support

business-to-business (B2B), and business-to-consumer (B2C) computing. This ERP platform, through SAP R/3, provides the integrative environment that links technology, business, and strategy. It is only through such an integrated enterprise model, that students can appreciate the technical solutions to business problems. Furthermore, they will learn key consulting skills within the design of the business process model.

The grounding of skill development in such a rich and commercially aware environment allows for greater student understanding and immediate application in the employment market, thus addressing a criticism being currently leveled at university technology and business education. Thus, the development and implementation of curriculum utilizing this Enterprise Wide System forms the basis of sustained change in curriculum design. The implementation of problem based learning experiences is the basis of sustained change in curriculum delivery, and provides tight coupling with industry needs.

Teaching cases will be designed to orient IT students to business application development, and to orient business students towards exploiting IT for strategic gain. We expect that the development of the implemented business model and associated teaching material will lead to more universities seeking to integrate R/3 experience into their IT, business and manufacturing engineering curricula. This project is also a vehicle to provide a platform for integrated IT, business and manufacturing engineering studies. This model and associated teaching and learning resources will not only help to address the paucity of curriculum materials for the Alliance Universities but will make the newly developed curriculum materials accessible to all universities and colleges.

The development of such a model in the business world costs tens of millions of dollars, as the system needs significant consulting effort to integrate into a real organization. The modeling exercise is costly, and beyond the funds of a single university. The model of collaborative curriculum development (Stewart and Rosemann 1999) seeks to forge links between university academics throughout the SAP University alliance, thus reducing curriculum development costs while increasing quality and penetration of appropriate curriculum.

There is a real opportunity for effective collaborations between universities in developing this rich teaching case base, if we can work across the supply chain. We have shown how this work is being distributed through the universities involved in the pilot. This collaboration may also be extended between university and industry. For example, one university may have the support of the manufacturer of the central product line, another university may be able to work with the distribution channels and transport companies that actually distribute the product, and yet a third university may be ideally placed to work directly with the raw ingredient providers. This means of interaction then provides realistic problems for the students of these universities, generates meaningful research and consultancy links with the targeted industry sector in the supply chain, and localizes activities. This relationship is a win-win, as would also be those universities that seek to collaborate on developing best-practice process models for specific functions within the core industry. For example, it is possible for universities specializing in inventory control systems to collaborate to find better inventory control systems for the specific food processing industry. We invite participants at the conference to approach us about being full and active collaborative partners in this project.

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